4.1.3.2 Environmental Impacts

4.1.3.2.1 No Action

Under this alternative, DOE would maintain L-Lake in its current state. The water table aquifer gradient, level, and flow rate should remain constant because the L-Lake outfall would continue to discharge; therefore, the aquifer would maintain reservoir elevation. At L-Area, this alternative would not affect contaminants in this aquifer. Infiltration of water from the River Water System does not occur at L-Reactor but downgradient of L-Reactor at the L-Lake outfall and, therefore, would not mobilize contaminants in the water table aquifer. Because L-Lake and the first confined aquifer are not in direct communication at the lake, the continued operation of the River Water System would not affect groundwater conditions in the first confined aquifer.

Under the No-Action Alternative, the River Water System would provide fire protection water for K- and L-Areas. DOE would minimize the need for river water by using the existing pumps screened into the deeper aquifers (Crouch Branch and McQueen Branch) more under this alternative. However, the nature and character of these aquifers would not change. The net increased well water demand would be approximately 200 gallons per minute (0.013 cubic meter per second) for each area.

4.1.3.2.2 Shut Down and Deactivate

Under this alternative, DOE would allow L-Lake to drain. Because the water table aquifer conditions are currently influenced by L-Lake, groundwater gradients, levels, and flow rates probably would change. Calculations demonstrate the water table elevation at the L-Area Oil and Chemical Basin (one of four CERCLA units) would drop approximately 4 feet (1 meter), the local gradient would steepen and local velocities would increase approximately 12 percent (Halliburton NUS 1996). By lowering the level of water in the aquifer, a possible effect could be to strand contamination within the vadose zone. If, in fact, the water table aquifer is homogeneous, then contaminant migration would be accelerated by the increased velocities. An earlier study indicated that the travel time from the L-Reactor seepage basin (another one of the four CERCLA units) would be 21 years to L-Lake compared to 18 years to natural Steel Creek level (DOE 1984).

Removal of the water from L-Lake would have little effect on groundwater elevation, gradient, flow rates, or flow direction in the first confined aquifer, which is not in direct communication with the lake or the water table aquifer. This aquifer contains no known contamination. River Water System outfalls do not directly influence the first confined aquifer, so discontinuation of the L-Lake outfall would have no effect on this aquifer. There is a possibility that the reduction of reservoir levels could influence the downward flow into the first confined aquifer below the dam.

As compared with the No-Action Alternative, this alternative would cause a further increase at K- and L-Areas in the demand for groundwater from the deeper aquifers of up to 200 gallons per minute (0.013 cubic meter per second) at each reactor area. Aquifer conditions would not change.

4.1.3.2.3 Shut Down and Maintain

The impacts discussed above for the Shut Down and Deactivate Alternative would apply to this alternative.

4.1.4 AIR RESOURCES

4.1.4.1 Affected Environment

4.1.4.1.1 Climate and Meteorology

The climate at the SRS is temperate, with short mild winters and long humid summers. Warm, moist maritime air masses affect the weather throughout the year (Hunter 1990).

Summer weather usually lasts from May through September, when the western extension of the semipermanent Atlantic subtropical "Bermuda" high-pressure system strongly influences the area. Winds are relatively light, and migratory low-pressure systems and fronts usually remain well to the north of the area. The Bermuda high is a relatively persistent feature, resulting in few breaks in the summer heat. Climatological records for the Augusta, Georgia, area indicate that during the summer months, high temperatures were greater than 90°F (32°C) on more than half of all days. The relatively hot and humid conditions often result in scattered afternoon and evening thunderstorms (Hunter 1990).

The influence of the Bermuda high begins to diminish during the fall, resulting in relatively dry weather and moderate temperatures. Fall days are frequently characterized by cool clear mornings and warm sunny afternoons (Hunter 1990).

During the winter, low-pressure systems and associated fronts frequently affect the weather of the SRS area. Conditions often alternate between warm, moist subtropical air from the Gulf of Mexico and cool, dry polar air. The Appalachian Mountains to the north and northwest of the SRS moderate the extremely cold temperatures associated with occasional outbreaks of arctic air. As a consequence, fewer than one-third of all winter days have minimum temperatures below freezing, and temperatures below 20°F (-7°C) occur infrequently. Snow and sleet occur on average less than once a year (Hunter 1990).

Outbreaks of severe thunderstorms and tornadoes occur more frequently during the spring than during the other seasons. Although spring weather is variable and relatively windy, temperatures are usually mild (Hunter 1990).

Precipitation

The annual average precipitation for the SRS is 48.2 inches (122 centimeters). Table 4-3 lists the monthly average and extreme precipitation amounts for the Site. Precipitation is fairly well distributed throughout the year. Average precipitation during the fall months (September, October, and November) is slightly less than the averages for the other seasons, accounting for about 18 percent of the average annual total. The maximum rainfall amount in a monthly period was 19.6 inches (50 centimeters) in October 1990 (Shedrow 1993). The maximum annual rainfall amount for the SRS was 73.5 inches (187 centimeters) in 1964; the record minimum annual amount was 28.8 inches (73 centimeters) in 1954 (Hunter 1990).

In Augusta, Georgia, the greatest observed rainfall for a 24-hour period was 8.6 inches (22 centimeters) in October 1990 (NOAA 1995). Hourly observations indicate that rainfall rates are usually less than 0.5 inch (1.3 centimeters) per hour, although higher rates are likely during spring and summer thunderstorms (Hunter 1990).

Occurrence of Violent Weather

The SRS area experiences an average of 55 thunderstorms per year, half of which occur during the summer months of June, July, and August (Shedrow 1993). On average, lightning flashes will strike six times per year on 0.39 square mile (1 square kilometer) of ground (Hunter 1990). Thunderstorms can generate wind speeds as high as 40 miles (64 kilometers) per hour and even stronger gusts. The highest 1-minute wind speed recorded at Bush Field in Augusta, Georgia, between 1950 and 1994 was 62 miles (100 kilometers) per hour (NOAA 1995).

Since SRS operations began, nine confirmed tornadoes have occurred on or close to the Site; eight caused light to moderate damage. The tornado of October 1, 1989, caused considerable damage to timber resources on about 1,097 acres (4.4 square kilometers) and lighter damage on about 1,497 acres (6 square kilometers) over southern and eastern areas of the Site. Estimated wind speeds for this tornado were as

Table 4-3. Monthly precipitation amounts for the Savannah River Site.[a,b,c]

Month	Average	Maximum[d]	Minimum[d]
January	4.17	10.02 (1978)	0.89 (1981)
February	4.61	7.94 (1956)	0.94 (1968)
March	5.02	10.96 (1980)	1.31 (1985)
April	3.49	8.20 (1961)	0.57 (1972)
May	4.23	10.90 (1976)	1.33 (1965)
June	4.36	10.89 (1982)	1.54 (1979)
July	5.02	11.48 (1982)	0.90 (1980)
August	4.85	12.34 (1964)	1.04 (1963)
September	3.74	8.71 (1959)	0.49 (1985)
October	2.49	10.86 (1959)	0.00 (1963)
November	2.60	6.46 (1957)	0.21 (1958)
December	3.63	9.55 (1981)	0.46 (1955)
Annual	48.21	73.47 (1964)	28.82 (1954)

a. Source: Hunter (1990).
b. Total inches, water equivalent; to convert inches to centimeters, multiply by 2.54.
c. Period of record, 1951-1987.
d. Year of occurrence given in parentheses.

high as 150 miles (240 kilometers) per hour (Shedrow 1993).

Thirty-six hurricanes caused damage in South Carolina between 1700 and 1992 (Shedrow 1993). The average frequency of occurrence of a hurricane in the state is once every 8 years; however, the observed interval between hurricanes has ranged from as short as 2 months to as long as 27 years. Eighty percent of these hurricanes have occurred in August and September (Hunter 1990).

Wind Speed and Direction

Figure 4-14 shows a joint frequency summary (wind rose) of hourly averaged wind speeds and directions collected from the H-Area meteorological tower at a height of 200 feet (61 meters) during the 5-year period from 1987 through 1991. This figure indicates that the prevailing winds are from the south, southwest, west, and northeast. Winds from the south, southwest, and west occurred during about 35 percent of the monitoring period (Shedrow 1993).

The average wind speed for the 5-year period was 8.5 miles (14 kilometers) per hour. Hourly averaged wind speeds less than 4.5 miles (7.2 kilometers) per hour occurred about 10 percent of the time. Seasonally averaged wind speeds were highest during the winter [9.2 miles (15 kilometers) per hour] and lowest during the summer [7.6 miles (12 kilometers) per hour] (Shedrow 1993).

Atmospheric Stability

The air dispersion coefficients used in modeling are determined by atmospheric stability. Air dispersion models that predict downwind ground-level concentrations of an air pollutant released from a source such as a dried lakebed are based on specific parameters such as vegetative cover, soil crusting, soil particle size, wind speed, and air dispersion coefficients.

The ability of the atmosphere to disperse air pollutants is frequently expressed in terms of the seven Pasquill-Gifford atmospheric turbulence (stability) classes A through G. DOE has determined occurrence frequencies for each stability class at the SRS using meteorological data collected from 1987 through 1991 at the onsite meteorological towers. Relatively turbulent atmospheric conditions that increase atmospheric dispersion, represented by the unstable classes A, B, and C, occurred approximately 56 percent of the time. Stability class D, which represents conditions that are moderately favorable for atmospheric dispersion, occurred approximately 23 percent of the time. Relatively stable conditions that minimize atmospheric dispersion, represented by classes E, F, and G, occurred about 21 percent of the time (Shedrow 1993).

4.1.4.1.2 Existing Radiological Conditions

Ambient air concentrations of radionuclides at the SRS include radionuclides of natural origins, such as radon from uranium in soils, manmade radionuclides such as fallout from nuclear weapons testing, and emissions from coal-fired and nuclear powerplants. DOE operates a 35-station atmospheric surveillance program at the SRS, with stations inside the perimeter, on the perimeter, and at distances as far as 100 miles (161 kilometers) from the Site (Arnett, Mamatey, and Spitzer 1996).

Routine SRS operations release gases and particulates that emit alpha- and beta-gamma radiation. DOE uses gross alpha and nonvolatile beta measurements as a screening method to determine the concentrations of radionuclides in the air. TE

Table 4-4 lists the average 1990 to 1995 gross alpha radioactivity and nonvolatile beta radioactivity measured at the SRS and at distances of 25 to 100 miles (40 to 161 kilometers) from the Site. The results show no significant differences between onsite locations near operating facilities and those at the site perimeter and beyond (Arnett, Mamatey, and Spitzer 1996). The 1994 results show gross alpha concentrations dropping to near the 1990 levels. The cause of the higher levels between 1991 and 1993 is unknown, but modifications to the analytical procedures are likely (Arnett, Mamatey, and Spitzer 1996).

Tritium (predominantly as water) is the only radionuclide detectable at and beyond the SRS boundary. Tritium is released from routine operations at the separations areas, and in smaller amounts from the reactor areas and D-Areas. TE

Table 4-4. Average gross alpha and gross beta measured in air (microcuries per milliliter), 1990-1995.

	Average gross alpha					
Locations	1990	1991	1992	1993	1994	1995
On Site	1.3×10^{-15}	2.5×10^{-15}	1.8×10^{-15}	1.9×10^{-15}	1.4×10^{-15}	1.5×10^{-15}
Site perimeter	1.1×10^{-15}	2.6×10^{-15}	1.8×10^{-15}	1.8×10^{-15}	1.4×10^{-15}	1.4×10^{-15}
25-mile radius	1.0×10^{-15}	2.5×10^{-15}	1.7×10^{-15}	1.8×10^{-15}	1.4×10^{-15}	1.4×10^{-15}
100-mile radius	1.3×10^{-15}	2.6×10^{-15}	1.7×10^{-15}	2.0×10^{-15}	1.8×10^{-15}	1.6×10^{-15}
	Average gross beta					
Locations	1990	1991	1992	1993	1994	1995
On Site	1.8×10^{-14}	1.8×10^{-14}	1.9×10^{-14}	1.8×10^{-14}	1.7×10^{-14}	1.8×10^{-14}
Site perimeter	1.8×10^{-14}	1.8×10^{-14}	1.9×10^{-14}	1.9×10^{-14}	1.8×10^{-14}	1.8×10^{-14}
25-mile radius	1.8×10^{-14}	1.8×10^{-14}	1.8×10^{-14}	1.8×10^{-14}	1.8×10^{-14}	1.8×10^{-14}
100-mile radius	1.9×10^{-14}	1.8×10^{-14}	1.7×10^{-14}	2.0×10^{-14}	1.8×10^{-14}	1.8×10^{-14}

The highest tritium levels occur near H-Area, but they decrease with distance from the release point. Other onsite locations (F-Area and the Burial Ground) show concentrations substantially lower than those at H-Area but greater than at the Site boundary, while boundary tritium concentrations are higher than those on the 25-mile- (40-kilometer) radius. Total 1995 atmospheric releases for tritium, cesium-137, and cobalt-60 were 96,700 curies, 0.015 curie, and 0.00006 curie, respectively. Tritium in elemental and oxide forms accounts for more than 99 percent of the radioactivity released to the atmosphere from SRS operations.

The calculated dose to the maximally exposed individual from airborne releases using the CAP88 code during 1995 was 0.8 millirem, which is 0.8 percent of the EPA airborne emission standard of 10 millirem-per-year due to radioactive emissions from DOE facilities (40 CFR 61, Subpart A) (Arnett, Mamatey, and Spitzer 1996).

4.1.4.1.3 Nonradiological Ambient Air Concentrations

At present, SRS does not perform onsite ambient air quality monitoring. The State of South Carolina operates ambient air quality monitoring sites, including sites in Barnwell and Aiken Counties. These monitors classify air quality control regions of the state as either in compliance or out of compliance with National Ambient Air Quality Standards. SRS is in a designated attainment area because it complies with those standards for criteria pollutants, including sulfur dioxide, nitrogen oxides (reported as nitrogen dioxide), particulate matter [less than or equal to 10 microns in diameter (PM_{10})], carbon monoxide, ozone, and lead (SCDHEC 1996b).

The only criteria pollutant potentially affected by the actions proposed in this EIS is PM_{10} due to the resuspension of dried lakebed sediment. Calculated maximum boundary-line PM_{10} concentrations from existing SRS operations are 50.6 and 2.9 micrograms per cubic meter for a 24-hour and annual averaging time respectively (DOE 1995c). The maximum observed 24-hour and annual average PM_{10} concentrations during 1995 near the SRS were 62 and 19 micrograms per cubic meter, respectively (SCDHEC 1996b).

4.1.4.2 <u>Environmental Impacts</u>

4.1.4.2.1 No Action

The continued operation of the River Water System would have no additional or new impacts on the existing ambient air quality at SRS. DOE would maintain L-Lake at its current full level, and the potential for exposed sediments that could become airborne would be minimal.

As discussed in Section 4.1.2.1, the primary contaminants in L-Lake are radionuclides and metals. No organic contaminants are present in the lakebed or floodplain at levels that are close to EPA Region IV risk-based concentrations, which DOE is using as screening levels at SRS (PRC 1996). Areas of highest contamination have been found in the Steel Creek floodplain.

4.1.4.2.2 Shut Down and Deactivate

The shutdown and deactivation of the River Water System would cause the level of water in L-Lake to recede as discussed in Section 4.1.2.2.2, and the lakebed could completely dry over several years. The drainage of L-Lake over several years could expose sediment covering as much as 920 acres (3.7 square kilometers) of surface area to windborne air currents (Ross 1996; Jones and Lamarre 1994). Winds could resuspend dried lake basin sediments (DOE 1996c; PRC 1996).

The amount of airborne contamination resulting from the exposure of the dried lakebed to airborne currents would depend on such parameters as the types and quantities of contamination in the sediment, the size of the dried lakebed exposed to air currents, the local meteorology (the occurrence of high wind speeds and precipitation), and the amount of vegetative cover on the soil. The level of contaminants that could volatilize from L-Lake sediments would be very low and, therefore, potential environmental impacts would be negligible (DOE 1996c; PRC 1996).

DOE used the Multimedia Environmental Pollutant Assessment System (MEPAS) model (Pacific Northwest Laboratory 1995) to estimate quantities of resuspended particulates originating from the dried lakebed. DOE obtained joint frequency wind data from the Savannah River Technology Center to represent the wind speeds and directions obtained from the L-Area meteorological tower for the period from 1986 to 1991 (Simpkins 1996a). The algorithm used by MEPAS to calculate the particulate emission factor has a parameter for the frequency of disturbances on the dried lakebed. For conservatism, a factor of 30 disturbances per month was used to estimate a worst-case particulate emission rate. The annual average concentration is conservatively calculated to equal the modeled 24-hour average concentration.

Table 4-5 lists the maximum concentration in air of nonradiological constituents at the boundary of the SRS. Included in the table is a column that shows the maximum allowable concentrations established by SCDHEC (SCDHEC 1976). As can be seen from the table, the resuspension of particulate matter from L-Lake produces only minimal concentrations by comparison to the allowable concentration.

Table 4-6 lists the maximum concentration in air of the radiological constituents at the boundary of the SRS. A column also is included in the table that shows the radiation dose resulting from annual exposure to this concentration of material. This radiation dose was calculated for all potential exposure pathways (e.g., ingestion of vegetation, direct exposure to radiation) that are the result of material being suspended and transported to the site boundary. These doses are much less than the 10 millirem per year requirement in 40 CFR 61.

A net benefit to the environment would be the reduction of fugitive evaporative tritium emissions from the L-Lake surface. The maximum calculated reduction in airborne tritium concentration at the SRS boundary is 0.073 picocurie per cubic meter.

Table 4-5. Maximum ground-level concentrations of nonradiological air constituents at the Savannah River Site boundary under the Shut Down and Deactivate Alternative.

Nonradiological Constituent	Modeled maximum air concentration[a] ($\mu g/m^3$)	Maximum allowable concentration[b] ($\mu g/m^3$)
Antimony	8.6×10^{-6}	2.5
Arsenic	2.2×10^{-5}	1.0
Beryllium	2.9×10^{-6}	0.01
Cadmium	1.3×10^{-6}	0.25
Lead	1.8×10^{-5}	1.5 (calendar quarter average)
Manganese	3.8×10^{-7}	25
PM_{10}[c]	1.2	50 (annual average) 150 (24-hour average)

a. DOE assumed 30 disturbances per month (i.e., once per day) of the lakebed so that the calculated air concentration is an upper bound of the concentration over any time period (e.g., week, month, year).

b. Source: SCDHEC (1976).

c. PM_{10} is particulate matter with a diameter of 10 microns (0.00001 m) or less.

TC

Table 4-6. Maximum ground-level concentrations of radiological air constituents at the Savannah River Site boundary under the Shut Down and Deactivate Alternative.

Radiological Constituent	Modeled maximum air concentration[a] (pCi/m^3)	Dose from all pathways (mrem/yr)
cesium-137	7.2×10^{-6}	3.6×10^{-4}
cobalt-60	1.1×10^{-7}	1.6×10^{-6}
plutonium-239	7.9×10^{-9}	3.5×10^{-5}
TC promethium-146	7.9×10^{-9}	9.5×10^{-9}
uranium-233	9.6×10^{-7}	9.3×10^{-5}
thorium-229	4.5×10^{-9}	4.7×10^{-6}
radium-225	4.5×10^{-9}	1.8×10^{-7}
actinium-225	4.5×10^{-9}	3.0×10^{-8}

a. DOE assumed 30 disturbances per month (i.e., once per day) of the lakebed so that the calculated air concentration is an upper bound of the concentration over any time period (e.g., week, month, year).

4.1.4.2.3 Shut Down and Maintain

The effects of this alternative would be the same as those described in Section 4.1.4.2.2. Impacts to the existing SRS ambient air quality would be minimal.

4.1.5 ECOLOGY

This section describes the plant and animal communities in and around L-Lake, and characterizes the potential impacts of the Proposed Action and alternatives. The Affected Environment and Environmental Impacts sections are divided into three categories based on the wildlife habitat that is present: Terrestrial Ecology, Aquatic Ecology, and Wetlands. Section 4.1.5.1 describes the affected environment by habitat type; the potential impacts of the Proposed Action and alternatives are discussed in Section 4.1.5.2.

Wetlands and potential impacts to wetlands are discussed in considerable detail in Sections 4.1.5, 4.2.5, and 4.3.5, in accordance with the requirements of 10 CFR 1022. The floodplain and wetlands assessment required by 10 CFR 1022 is included in these sections. Section 4.3.5.3 discusses threatened and endangered species separately because several, such as the bald eagle and wood stork, range widely, and thus are not restricted to a particular drainage basin or reservoir. They also warrant additional consideration because they are protected by Federal law and therefore have special status under the National Environmental Policy Act (40 CFR 1508.27).

4.1.5.1 Affected Environment

L-Lake contains phytoplankton, zooplankton, macroinvertebrate, and fish communities characteristic of productive southeastern reservoirs with significant nutrient inputs and long growing seasons. A variety of reptiles and amphibians also occur in and around the lake. Birds (shorebirds, wading birds, and birds of prey) and mammals forage around L-Lake and drink its water. Several thousand ducks use L-Lake in winter. Small numbers of (threatened) bald eagles, (endangered) wood storks, and (threatened) American alligators are found in the L-Lake area at certain times of the year.